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International Reference Group on Great Lakes Pollution from Land Use Activities

INTERNATIONAL REFERENCE GROUP ON GREAT LAKES POLLUTION FROM LAND USE ACTIVITIES

INTERNATIONAL JOINT COMMISSION

INVENTORY OF LAND USE AND LAND USE PRACTICES
VOLUME II CANADIAN LAKE SUPERIOR BASIN

INVENTORY OF LAND USE AND LAND USE PRACTICES IN THE CANADIAN GREAT LAKES BASIN

REPORT OF THE INTERNATIONAL REFERENCE GROUP ON GREAT LAKES POLLUTION FROM LAND USE ACTIVITIES

VOLUME II
CANADIAN LAKE SUPERIOR BASIN

DECEMBER, 1977

INVENTORY OF LAND USE AND LAND USE PRACTICES IN THE CANADIAN GREAT LAKES BASIN with Emphasis on Certain Trends and Projections to 1980, and Where Appropriate, to 2020.

To be used as portion of the Canadian Task B Report on GREAT LAKES POLLUTION FROM LAND USE ACTIVITIES BY the International Joint Commission.

ACKNOWLEDGEMENTS

This report was assembled by many people working on the Canadian portion of the Task B Study planned through the Pollution From Land Use Activities Reference Group (PLUARG) of the International Joint Commission.

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The material for these reports was assembled from existing census and other data available in 1972 - 1975.

Five volumes were prepared, one each for Lakes Superior, Huron, Erie and Ontario, and a summary volume for the Canadian portion of the Great Lakes Basin.

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PREFACE

As its title suggests, this volume presents an Inventory of Land Use and Land Use Practices in the Canadian Great Lakes Basin, with emphasis on certain trends and projections to 1980 (and to 2020 where appropriate). The report integrates several studies by contractors and sub-contractors. These studies were part of the Canadian Task B effort for the Great Lakes Pollution from Land Use Activities Reference Group, International Joint Commission.

The Task B report for the Canadian part of the Great Lakes Basin is contained in five volumes:

Volume	I	Canadian Great Lakes Basin Summary
Volume	II	Lake Superior Basin
Volume	III	Lake Huron Basin
Volume	IV	Lake Erie Basin
Volume	V	Lake Ontario Basin

Knowledge of present and future land use and land use practices are important as background for evaluating and controlling non-point sources of water pollution. This report describes and quantifies, as appropriate, the Canadian Great Lakes Basin's geology, soils, minerals, climate, surface and ground water, vegetation, wildlife, and economic and demographic characteristics. It inventories available information on waste disposal operations, lakeshore and riverbank erosion, high-density non-sewered residential areas and recreational land uses, as well as materials application of agricultural chemicals, fertilizers, animal wastes and salts on highways. Finally, future trends and projections are shown for the above categories.

This Canadian Great Lakes Basin Summary and each of the four Canadian lake basin volumes have been reviewed by Joint Task Group B, whose comments were considered before approval for final report development. This study forms a Canadian contribution to the Task B effort of the Study on Great Lakes Pollution from Land Use Activities.

The study discussed in this report was carried out as part of the efforts of the Pollution from Land Use Activities Reference Group, an organization of the International Joint Commission, established under the Canada-U.S. Great Lakes Water Quality Agreement of 1972. Findings and conclusions are those of the author(s) and do not necessarily reflect the views of the Reference Group or its recommendations to the Commission.

SUMMARY

PHYSICAL FABRIC

The Canadian portion of the Lake Superior Basin lies entirely within the Province of Ontario. It has a land area of 9,458,748 ha (23.4 million acres) which represents 41 percent of the Canadian Great Lakes Basin, yet contains only two percent of the basin's population and economic activity. The entire Canadian Lake Superior Basin is underlain by the Precabrian or Canadian Shield. Soils are shallow and infertile in most areas, and topography is variable. The climate is characterized by long cold winters and short warm summers. Forest is the dominant vegetation type.

MAJOR LAND USES

The major land use in the Canadian portion of the Lake Superior Basin is forestry, covering 98.8 percent of the land area. The remaining land uses are agriculture, 0.5 percent; recreation, 0.2 percent; marsh, 0.2 percent; urban, 0.1 percent; and barren land, 0.1 percent.

SPECIALIZED LAND USES

There are 56 mine tailings disposal sites in the Canadian portion of the Lake Superior Basin, 12 of which are associated with active mines.

There are 97 waste disposal sites which cover 516 ha (1275 acres) of land and receive 557 t/d (1.22 million lb/d) of waste.

Little erosion takes place on the Lake Superior shoreline because of its rocky and non-erodible nature.

Approximately eight percent of the Canadian Lake Superior Basin population lives in high density, non-sewered residential areas.

MATERIALS USAGE

Materials usage is small, relative to the lower Great Lakes basins, because of limited amount of agricultural land in the Canadian Lake Superior Basin. Estimated annual use of pesticides is 540 kg (1190 lb).

The total nutrients annually applied to land in the Canadian Lake Superior Basin from fertilizers and agricultural manures are: 1220 t (2.7 million lb) of nitrogen, 1070 t (2.35 million lb) of phosphorus (P_2O_5); and 1340 t (2.95 million lb) of potassium (K_2O).

In an average winter 28,400 t (62.5 million lb) of salt are applied to roads in the Canadian Lake Superior Basin.

FUTURE TRENDS

Population in the Canadian portion of the Lake Superior Basin is expected to grow from 147,914 in 1971 to 181,025 by the year 2021. Total output (real domestic product) is projected to increase from 515.71 (millions of 1961 dollars) to 3766.28 over the 50 year period. Forecasts of the major land uses show no major changes. Basically, urban land and recreational land are predicted to increase and forest and agriculture are predicted to decline. The future pattern and extent of specialized land uses in the Canadian Lake Superior Basin will be more a function of interacting social, technological and legislative factors than of population and economics. The use of fertilizer is projected to decline from about 1000 t (2.2 million lb) of nutrients in 1971 to about 700 t (1.6 million lb) in 2020. However, the use of road salt is projected to increase at a steady rate, reaching 39,400 t (86.7 million lb) in 2020.

INTRODUCTION

INTRODUCTION

The Boundary Waters Treaty (1909) states in part that the boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health and property on the other side. In accordance with this treaty and the Water Quality Agreement of 1972, the governments of Canada and the United States requested that the International Joint Commission conduct a study on pollution of the boundary waters of the Great Lakes System by agriculture, forestry and other land use practices.

Studies completed during 1969 demonstrated that diffuse land drainage sources of pollutants were not only significant, but also were difficult to measure. As a result of those findings, the International Joint Commission called upon the Great Lakes Pollution from Land Use Activities Reference Group to provide a better definition of the impact of land use activities, practices and programs on water quality in the Great Lakes.

DETAILED STUDY PLAN

The February 1974 Detailed Study Plan emphasized four main tasks:

TASK A - assessment of problems, management of programs and research, and the attempt to set priorities in relation to the best information now available on the effects of land use activities on water quality in boundary waters of the Great Lakes.

TASK B - inventory of land use and land use practices, with emphasis on certain trends and projections to 1980 and, if possible, to 2020.

TASK C intensive studies of a small number of representative watersheds, selected and conducted to permit some extrapolation of data to the entire Great Lakes Basin and to relate contamination of water quality, which may be found at river mouths on the Great Lakes, to specific land uses and practices.

TASK D - diagnosis of the degree of impairment of water quality in the Great Lakes, including assessment of concentrations of contaminants of concern in sediment, fish and other aquatic resources.

PURPOSE

The objectives of TASK B were: 1) to provide information on the physical fabric of the Great Lakes Basin, including soils and their capability, hydrology, geomorphology, climate, mineral and gas resources, and borad vegetation zones; 2) to provide a general land use inventory of the Great Lakes Basin; 3) to provide specific information concerning the nature and location of defined specialized land use categories in the Great Lakes Basin; 4) to provide an inventory of various materials applied to land which may influence the quality of drainage waters; and 5) to provide a consistent and comprehensive set of forecasts for 1980 and 2020 relating to land uses and land use activities based upon socioeconomic, technological, and political development.

1 PHYSICAL FABRIC

CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

The Canadian portion of the Lake Superior Basin lies entirely within the Province of Ontario. It has a land area of 9,458,748 ha (23.4 million acres), which represents 41 percent of the Canadian Great Lakes Basin.

For purposes of this report, the Lake Superior Basin has been divided into three major sub-basins: 1) Sub-Basin 1 - the Kaministikwia; 2) Sub-Basin 2 - Nipigon - Long Lac - White; and 3) Sub-Basin 3 - Magpie - michipicoten - Montreal. The boundaries of these sub-basins are illustrated in Figure 1.

LAND RESOURCES

GEOLOGY

The Lake Superior Basin comprises part of the larger geologic area, the Canadian Shield, which is underlain by ancient volcanic, sedimentary and metamorphic rocks formed in the Precambrian Era.

During the early Precambrian Era, the earth's crust was subjected to several periods of fracturing, mountain building, volcanism and erosion. Greenstone belts, or zones of metamorphosed, complexly-folded volcanic, sedimentary and instrusive rocks, were formed at that time, separated by large expanses of banded gneiss and granitic rocks.

Sedimentation and volcanism during the middle to late Precambrian Era deposited thick sequences of relatively flat-lying sedimentary and volcanic rocks in the Thunder Bay - Lake Nipigon - Terrace Bay area. These formations were intruded during the Precambrian Era by sills and dikes of diabase and gabbro.

TOPOGRAPHY AND SOILS

Three main surficial features and soil texture areas have been identified in the Canadian Lake Superior Basin. Lacustrine clay and silt deposits are located near Thunder Bay, around Lake Nipigon, north of Long Lac and around Marathon. These deposits are significant because of their relatively high biological productivity. Sand and gravel deposits are located in the area north of Lake Nipigon. Outwash deposits of stratified granular material occur in the area between Ignace and Lake Nipigon.

Ground moraine is the most widely distributed surficial type in the Canadian Lake Superior Basin. It consists of sandy till mixed with large amounts of boulders, stones and gravel. It contains very little clay and is less than three feet in depth.

FIGURE 1: CANADIAN PORTION OF THE LAKE SUPERIOR DRAINAGE BASIN

Topography in the Canadian portion of the Lake Superior Basin is quite varied. The northern portion of the Basin is predominantly undulating terrain, except for several areas west of Nipigon, which have quite high relief. The areas to the south, near the shoreline, show moderate and strong relief.

CLIMATE

The main features of the climate of the Canadian Lake Superior Basin are four distinct seasons and a variety of precipitation types and sources. However, there is almost no month-to-month variation in the amount of precipitation.

The Basin experiences very cold winters, with the $-18^{\circ}C$ January mean isotherm running across the southern end of Lake Nipigon. The warming effect of Lake Superior is very noticeable in winter, with Thunder Bay having a January mean temperature of $-14^{\circ}C$.

The steep northeastern shore of Lake Superior exhibits the heaviest precipitation in the Canadian Great Lakes Basin. Throughout most of the Canadian Lake Superior Basin, winter snowfall averages 150 to 250 cm (59 to 98 in). In most winters, the warm spells are not sufficiently warm or long enough to melt much of the snow. As a result snow accumulation on the ground can reach 75 cm (30 in) or more by winter's end.

The significance of the Canadian Lake Superior Basin climate, with respect to land drainage, lies in: (1) the severe constraints it imposes on agriculture; and (2) the fact that winter temperatures are often too low for the effective use of salt on roads and highways.

HYDROLOGY

SURFACE WATER

Lake Superior is the largest freshwater lake in the world, with a volume of 12,510 km^3 (4.42×10^{14} ft^3) and a surface area of 82,100 km^2 (31,700 mi^2). The Basin also contains hundreds of inland lakes, the largest being Lake Nipigon. The surface water drainage of the Canadian Lake Superior Basin is illustrated in Figure 1. The quality of surface water in this area is generally high. The major Canadian Lake Superior sub-basins are listed in Table 1.

TABLE 1

WATERSHED DIVISIONS IN THE CANADIAN PORTIONS OF THE LAKE SUPERIOR BASIN

		CODE
Sub-Basin 1:	Kaministikwia River	
	Pigeon River	2AA
	Kaministikwia and Current Rivers	2AB
	Black Sturgeon River	2AC
Sub-Basin 2:	Nipigon - Long Lac - White Rivers	
	Nipigon River and Ogoki Diversion	2AD, 4GB
	Little Pic River, Long Lac Diversion and North Shore	2AE, 2BA, 4JD
	Black and Pic Rivers	2BB
	Pakaskwa and White Rivers	2BC
Sub-Basin 3:	Magpie - Michipicoten - Montreal Rivers	
	Michipicoten, Magpie and University Rivers	2BD
	Montreal and Agawa Rivers	2BE
	Goulais, Harmony and Batchawana Rivers	2BF

GROUND WATER

Ground water in the Canadian portion of the Lake Superior Basin is of variable quality and quantity, depending on the geology and soils of each area. The bedrock of the Precambrian Shield is generally a poor aquifer. However, in some areas fair aquifers are found in the glacial overburden.

VEGETATION ZONES AND WILDLIFE HABITAT

The Canadian portion of the Lake Superior Basin is 99 percent forest-covered. The Nipigon - Long Lac - White River Sub-Basin is in the Boreal Forest Region. The southern parts of the Kaministikwia and the Magpie - Michipicoten - Montreal River Sub-Basin lies in the Great Lakes - St. Lawrence Forest Region. These forests are the climax communities of the Canadian Lake Superior Basin, and their watersheds yield high quality water. Only a small amount of land around Thunder Bay has been cleared for agriculture and urbanization.

White and black spruces, tamarack, balsam firs and jack pine are characteristic species of the Boreal Forest Region. While the forests are primarily coniferous, there is a general admixture of broadleaved trees, such as white birch and its varieties, trembling aspen and balsam poplar.

The Great Lakes - St. Lawrence Forest Region is characterized by a mixed forest, consisting of eastern white and the red pines, eastern hemlock and yellow birch. Common to this region are such species as sugar maple, red maple, red oak, basswood and white elm. Other wide-ranging species are the eastern white cedar and largetooth aspen, and to a lesser extent, beech, white oak, butternut and white ash. Boreal species, such as the white and black spruces, balsam fir, jack pine, trembling aspen, balsam popular and white birch, are intermixed.

The forests of the Canadian portion of the Lake Superior Basin provide abundant habitat for a wide variety of wildlife species.

DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

POPULATION

The Canadian portion of the Lake Superior Basin is sparsely populated, containing only two percent of the total Canadian Great Lakes Basin population in 1971. Of the 147,914 persons living in the Canadian Lake Superior Basin, 108,411 (73 percent) reside in Thunder Bay. The distribution of this population among the three major sub-basins is as follows: Kaministikwia - 115,294; Nipigon - Long Lac - White - 26,280; and Magpie - Michipicoten - Montreal - 6,340.

RESOURCE USE AND DEVELOPMENT

Economic activity in the Canadian portion of the Lake Superior Basin is presented in Table 2. About 80 percent of the economic activity is located in the Kaministikwia Sub-Basin. Examination of the land-based industries (i.e., agriculture, forestry, fisheries and mining) indicates that mining ranks first in the Basin, in terms of economic output. Forestry is second, and agriculture and fisheries contribute only negligible amounts.

TABLE 2

ECONOMIC ACTIVITY IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN, 1972

Real Domestic Product by Major Industrial Group (millions of 1961 dollars)

	Kaministikwia River (Sub-Basin 1)	Nipigon - LongLac-White Rivers (Sub-Basin 2)	Magpie-Michipicoten-Montreal R. (Sub-Basin 3)	Total Canadian Lake Superior Basin
Agriculture	0.67	0.06	0.0	0.73
Forestry	9.07	5.93	0.31	15.31
Fisheries	0.13	0.11	0.02	0.26
Mining	7.59	21.75	13.71	43.05
Manufacturing	124.60	33.12	0.41	158.12
Construction	21.62	2.77	0.77	25.16
Transportation, Utilities, Trade and Other	237.58	28.87	6.65	275.10
Total Output, All Sectors	401.26	92.61	21.87	517.73

AGRICULTURE

The Kaministikwia Valley and the east shore of Black Bay are the only two areas in the Canadian portion of the Lake Superior Basin in which agriculture is practiced. Although the number of people involved is not large, and the value of production is not significant in relation to forestry and mining, agriculture is an important aspect of the social, economic and food supply system of the Basin.

The main agricultural activity in the Canadian Lake Superior Basin is dairy farming. Local farms provide all the fluid milk, 70 percent of the potatoes and 50 to 60 percent of the eggs required by the residents of Thunder Bay. Significant amounts of beef, pork and market garden produce are also produced in the area.

FORESTRY

Forestry is an important part of the economy of the Canadian portion of the Lake Superior Basin. Primary products include newsprint and allied paper products, lumber, railway ties and veneer.

MINING

Mining is one of the mainstays of the economy of the Canadian Lake Superior Basin, with large areas of moderate and high mineral potential present there. Table 3 contains information on locations, products and number of employees for six of the producing mines in the Basin. The total value of the minerals sold in 1972 from five of the six mines was $88,846,000.

TABLE 3

INFORMATION ON SIX PRODUCING MINES IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN, 1973

Company	Location	Products	Employees
Algoma Development Corporation	Beardmore	Gold	2
International Nickel Company	Shebandowan	Nickel, Copper	325
Noranda Mines (Geco Division)	Manitouwadge	Zinc, Copper, Lead	675
Thunder Bay Amethyst	Thunder Bay	Amethyst Stone	4
Wilroy Mines	Manitouwadge	Zinc, Copper, Silver, Lead	165
Total			1,171

RECREATION

An evaluation of recreation in the Canadian portion of the Lake Superior Basin was done on the basis of land capability. Capability for intensive recreation was derived from the Canada Land Inventory. Capability for extensive or dispersed recreation was determined by relating water patterns and topography.

Three areas exhibit very high capability for intensive recreational use. Two of these areas are Thunder Bay and vicinity, including the Nor-Westers, and the Sibley Peninsula. In both places, there are a variety of features and all-season recreation potential. The Bathchawana - Goulais Bay area is also outstanding because of its sand beaches, ski hills, waterfalls and rock formations.

The capability for extensive recreation includes broad considerations for such uses as canoeing, walking and dispersed cottaging. Areas with high capability for extensive recreation include the Canadian Lake Superior shoreline and the Lake Nipigon shoreline.

SOURCE MATERIALS

Bangay, G. Population Estimates for the Great Lakes Basins and their Major Tributaries, Social Science Series No. 1, Inland Waters Directorate, Canada Centre for Inland Waters, Burlington, Ontario, 1973.

Phillips, D.W. and J.A.W. McCulloch. The Climate of the Great Lakes Basin, Climatological Studies Number 20, Atmospheric Environment Service, Environment Canada, Toronto, 1972.

2 MAJOR LAND USES

INTRODUCTION

The land use classification scheme used in this report is described below,followed by presentation of the results. A discussion of methodology is presented in Appendix A of Volume I in this report series.

LAND USE CLASSIFICATION SYSTEM

INTRODUCTION

The factors taken into consideration during the development of the classification system are as follows: 1) nature of the data required; 2) data collection methodologies available; 3) cost of data acquisition; 4) comparability of the data from both countries; and 5) timeliness of information.

The fact that the land use data were to be used in studies related to water quality dictated that land use categories should be different with respect to water runoff, types of pollution, degree of pollution, etc. The land use categories used in the inventory of Canadian portion of the Lake Superior Basin are defined in Table 4.

TABLE 4

LAND USE CLASSIFICATION DEFINITIONS

URBAN - Land used for residential, commercial, industrial or institutional purposes.

Residential - Land used for residential purposes. Single and multiple dwelling units in the built-up portions of cities and towns were included in this category. Areas of urban sprawl, such as country estates and strip residential developments, were also included.

Low density residential - Land used for residential purposes which had 10 percent or less man-made surface ground cover. Category included, for example, strip residential and country estates.

Medium density residential - Land used for residential purposes which had 10 to 25 percent man-made surface ground cover. This category included, for example, urban fringe subdivision - type developments.

High density commercial- industrial - Land used for commercial, industrial or institutional purposes which had greater than 25 percent man-made surface ground cover.

Transportation - Land used for transportation facilities such as rail yards, highway interchanges, airports and airstrips.

EXTRACTIVE - Land used for the extraction of earth materials, including open pit mines, strip coal mines, commercial mineral excavations, commercial topsoil removal operations, etc. Idle land held in reserve was included in this category.

SLAG HEAPS - Land used for commercial dumping of mine tailings, chemicals and slag. This category was of particular significance in the Sudbury area.

OUTDOOR RECREATION - Land used for private or public outdoor recreation. This category included such things as developed national, provincial, municipal, city and private parks, wildlife sanctuaries, historical sites, race tracks, golf courses, drive-in theatres, marinas and cemetaries.

AGRICULTURE -

Orchards, Vineyards, Horticulture, Fur and Poultry Operations - Land used for the production of tree fruits and grapes, vegetables and small fruits, and large scale fur farms and poultry operations.

Cropland - Land used for the production of annual crops such as grain, tobacco or sugar beets.

Improved Pasture - Land used for pasture or for the production of hay and other fodder crops. To qualify as improved, a pasture had to exhibit some evidence of cultivation.

Unimproved Pasture - Included grasslands, such as natural range, and areas of sedges and herbaceous plants. Brush scrub and mature trees up to a maximum cover of 25 percent of the total area was included in this category.

FOREST - Land bearing forest, short trees or bushes in which the tree cover exceeded 25 percent.

MARSH & SWAMP - Open wetlands of all types were included in this category.

BARREN - Land which did not support vegetation. Examples included sand flats, barren rock, alkali flats, etc.

RESULTS

SUB-BASIN 1: KAMINISTIKWIA RIVER

The major land uses in the Kaministikwia Sub-Basin are listed by watershed in Table 5. Forest land constitutes 94 percent of this sub-basin area.

Nearly all of the urban land in the Kaministikwia Sub-Basin is located in the Kaministikwia and Current River watershed. In addition, 84 percent of the agricultural land in this sub-basin is located in this watershed.

Both the Pigeon River and the Kaministikwia and Current River watersheds have small amounts of recreation land. The Black Sturgeon River watershed contains 21,912 ha (54,144 acres) of land used for outdoor recreation.

SUB-BASIN 2: NIPIGON - LONG LAC - WHITE RIVERS

The majority of the land in the Nipigon - Long Lac - White River Sub-Basin, 99.8 percent, is classified as forest (Table 6).

Two of the watersheds in this sub-basin, the Black and Pic Rivers and the Pakaska and White Rivers, are entirely forest land. There are only 387 ha (956 acres) of urban land in the entire sub-basin, all located in the Little Pic, Long Lac and North Shore watershed. Small areas of agricultural land are found in the Nipigon River and Ogoki Diversion watershed and in the Little Pic, Long Lac Diversion, and North shore watershed. The Nipigon River and Ogoki Diversion watershed also contains 10,101 ha (24,960 acres) of marsh and swamp.

SUB-BASIN 3: MAGPIE - MICHIPICOTEN - MONTREAL RIVERS

Forest is the dominant land use in this sub-basin, covering 99 percent of the sub-basin land area. The Montreal and Agawa River watershed is 100 percent forest, while the Michipicoten, Magpie and University River watershed is also all forest, with the exception of 11,202 ha (27,680 acres) of barren land (Table 7).

A small amount of urban land (1561 ha or 3857 acres) is found in the Goulais, Harmony and Batchawana River watershed. This watershed also contains 4798 ha (11,856 acres) of pasture.

Outdoor recreation land, as defined, is practically non-existent in this sub-basin, with only 92 ha (227 acres) being found in the Goulais, Harmony and Batchawana River watershed.

TABLE 5

MAJOR LAND USES IN KAMINISTIKWIA RIVER SUB-BASIN
(SUB-BASIN 1)

Land Use	Pigeon R.	Kaministikwia and Current R.	Black Sturgeon R.	Total Sub-Basin 1
		Hectares (ha)		
Urban Areas > 25,000 pop.				
Commercial - Industrial				
Low Density	0	43	0	43
Medium Density	18	175	104	297
High Density	11	1607	0	1618
Total Com.-Indust.	29	1825	104	1958
Residential				
Low Density	0	640	0	640
Medium Density	0	2192	0	2192
High Density	0	653	0	653
Total Residential	0	3485	0	3485
Transportation	7	551	0	558
Total Urban > 25,000	36	5861	104	6001
Urban Areas < 25,000 pop.	52	654	20	726
Total Urban Areas	88	6515	124	6727
Extractive				
Extractive	3	522	64	589
Slag Heaps	0	0	0	0
Total Extractive	3	522	64	589
Outdoor Recreation	175	732	21,912	22,819
Agriculture				
Orchards, Hort., etc.	0	814	0	814
Cropland	123	1304	0	1427
Improved Pasture	3367	32,883	3287	39,537
Unimproved Pasture	348	3960	179	4487
Total Agriculture	3838	38,961	3466	46,265
Forest	168,768	684,003	483,452	1,336,223
Marsh and Swamp	307	3222	3440	6969
Barren	1	8	0	9
Total Watershed Land Area	173,180	733,963	512,458	1,419,601

acres = hectares (ha) x 2.471

Taken from Land Management Information Systems/Lands Directorate Environment Canada/Data Source C.L.I. and C.C.R.S. Maps

TABLE 6

MAJOR LAND USES IN THE NIPIGON-LONG LAC-WHITE RIVERS SUB-BASIN
(SUB-BASIN 2)

Land Use	Nipigon R. and Ogoki Diversion	Little Pic, LongLac Diversion and North-Shore	Black and Pic Rivers	Pakaska and White Rivers	Total Sub-Basin 2
	Hectares (ha)				
Urban Areas > 25,000 pop.					
Commercial-Industrial					
Low Density	0	0	0	0	0
Medium Density	0	0	0	0	0
High Density	0	0	0	0	0
Total Com.-Indust.	0	0	0	0	0
Residential					
Low Density	0	0	0	0	0
Medium Density	0	0	0	0	0
High Density	0	0	0	0	0
Total Residential	0	0	0	0	0
Transportation	0	0	0	0	0
Total Urban > 25,000	0	0	0	0	0
Urban Areas < 25,000 pop.	0	387	0	0	387
Total Urban Areas	0	387	0	0	387
Extractive					
Extractive	0	65	0	0	65
Slag Heaps	0	0	0	0	0
Total Extractive	0	65	0	0	65
Outdoor Recreation	0	0	0	0	0
Agriculture					
Orchards, Hort., etc.	0	0	0	0	0
Cropland	0	0	0	0	0
Improved Pasture	0	0	0	0	0
Unimproved Pasture	1425	259	0	0	1684
Total Agriculture	1425	259	0	0	1684
Forest	3,265,680	1,112,931	746.692	983,870	6,109,173
Marsh and Swamp	1,0101	1,105	0	0	11,206
Barren	0	0	0	0	0
Total Watershed Land Area	3,277,206	1,114,747	746,692	983,870	6,122,515

acres = hectares (ha) x 2.471
Taken from Land Management Information Systems/Lands Directorate Environment Canada/Data Source C.L.I. and C.C.R.S. Maps

TABLE 7

MAJOR LAND USES IN THE MAGPIE-MICHIPICOTEN-MONTREAL RIVERS SUB-BASIN
(SUB-BASIN 3)

Land Use	Michipicoten, Magpie and University R.	Montreal and Agawa Rivers	Goulais, Harmony and Batchawana R.	Total Sub-Basin 3
		Hectares (ha)		
Urban Areas > 25,000 pop.				
Commercial-Industrial				
Low Density				
Medium Density	0	0	8	8
High Density	0	0	284	284
Total Com.-Indust.	0	0	292	292
Residential				
Low Density	0	0	39	39
Medium Density	0	0	644	644
High Density	0	0	10	10
Total Residential	0	0	693	693
Transportation	0	0	36	36
Total Urban > 25,000	0	0	1021	1021
Urban Areas < 25,000 pop.	0	0	539	539
Total Urban Areas	0	0	1560	1560
Extractive				
Extractive	0	0	0	0
Slag Heaps	0	0	189	189
Total Extractive	0	0	189	189
Outdoor Recreation	0	0	92	92
Agriculture				
Orchards, Hort., etc.	0	0	0	0
Cropland	0	0	0	0
Improved Pasture	0	0	3239	3239
Unimproved Pasture	0	0	1559	1559
Total Agriculture	0	0	4798	4798
Forest	894,062	568,307	434,806	1,897,175
Marsh and Swamp	0	0	828	828
Barren	11,202	0	11	11,213
Total Watershed Land Area	905,264	568,307	442,284	1,915,855

acres = hectares (ha) x 2.471
Taken from Land Management Information Systems/Lands Directorate Environment Canada/Data Source C.L.I. and C.C.R.S. Maps

SOURCE MATERIALS

Gierman, D. and R.A. Ryerson. Land Use Information for the Great Lakes Basin, Report to Technical Committee B, Great Lakes Pollution from Land Use Activities Reference Group, International Joint Commission, Ottawa, 1974.

Thie, J., R.A. Ryerson and T.T. Alfoldi. Mapping Land Use in the Great Lakes Basin; an Evaluation of Conventional and Remote Sensing Techniques, Report to Technical Committee B, Great Lakes Pollution from Land Use Activities Reference Group, International Joint Commission, Toronto, August, 1973.

3 SPECIALIZED LAND USES

INTRODUCTION

Six specialized land use categories are inventoried in this report. They are as follows: 1) mine tailings disposal sites; 2) waste disposal sites; 3) shoreline erosion; 4) riverbank erosion; 5) intensive livestock operations; and 6) high density, non-sewered residential areas. These specialized land uses are discussed individually below.

DISPOSAL OPERATIONS

MINE TAILINGS DISPOSAL SITES (1)

INTRODUCTION

Data on mine tailings disposal sites (Table 8) in the Canadian portion of the Lake Superior Basin were assembled for Environment Canada. The sub-basins are discussed individually below (methodology is presented in Appendix A of Volume I in this report series).

SUB-BASIN 1: KAMINISTIKWIA RIVER

There are 19 mines in the Kaministikwia Sub-Basin which extract minerals requiring tailings disposal areas. Three of these mines are currently active, producing copper, silver, clay, granite, trap and limestone tailings.

SUB-BASIN 2: NIPIGON - LONG LAC - WHITE RIVERS

The Nipigon - Long Lac - White Sub-Basin contains 20 mine tailings disposal areas, four associated with active mines. Tailings from the following minerals are disposed in these areas: zinc, cadmium, gold, copper and silver.

SUB-BASIN 3: MAGPIE - MICHIPICOTEN - MONTREAL RIVERS

The Magpie - Michipicoten - Montreal Sub-Basin contains 17 mines which extract minerals requiring tailings disposal areas. Five of these are currently producing iron, copper and gold tailings.

SUMMARY

The 56 mine tailings disposal sites in the Canadian Lake Superior Basin are distributed evenly among the three sub-basins (Table 8). Twelve of the sites are active and handle copper, silver, clay, granite, trap and limestone, zinc, cadmium, gold and iron tailings.

TABLE 8

MINE TAILINGS DISPOSAL SITES IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

SUB-BASIN	WATER-SHED	DESCRIPTION	MINERALS
1	2AA	McKellar Isl. Occurrence	Barite
1	2AA	Great Lakes Nickel Mines Ltd.	Nickel
1	2AB	Badger (McWilliams) Mine	Silver
1	2AB	Cairngorm Mines Ltd.	Silver
1	2AB	Creswel Mines Ltd.	Silver
1	2AB	Federal Mine	Silver
1	2AB	Hewitson Construction Ltd.	Tin
1	2AB	Salem Exploration Ltd. (Rabbit Mountain Mine)	Silver
1	2AB	Shield Development Co. Ltd.*	Copper, Silver
1	2AB	Superior Brick and Tile Co. Ltd.*	Clay
1	2AB	Shebandowan	
1	2AC	Beck Mine	Silver
1	2AC	East Gunflint Iron Range	Iron
1	2AC	McNamara Construction Ltd.*	Tin
1	2AC	Ogema Mine	Lead, Zinc, Silver
1	2AC	Shuniah Mine	Silver
1	2AC	Silver Islet Mine	Silver
1	2AC	Three A Mine	Silver
1	2AC	Thunder Bay Amethyst Mines Ltd.	Amethyst
2	2AD	Brenbar Mines Ltd.	Gold
2	2AD	Jelex Mines Ltd.	Gold
2	2AD	Leitch Gold Mines Ltd.	Gold
2	2AD	Northern Empire Mine	Gold
2	2AD	Quebec Sturgeon River Mines Ltd.	Gold
2	2AD	Chromium Smelting & Mining Corp.	Chromium
2	2AD	Tashota Nipigon Mines Ltd.	gold
2	2BA	Zenmac Metal Mines Ltd.*	Zinc, Cadmium
2	4JD	Bankfield Consolidated Mines Ltd.	Gold
2	4JD	Conigo Mines Ltd. (Magnet Consolidated)	Gold
2	4JD	Consolidated Mosher Mines Ltd.*	Gold
2	4JD	Gulch Mines Ltd.	Gold
2	4JD	Hard Rock Gold Mines	Gold, Silver
2	4JD	Little LongLac Gold Mines Ltd.	Gold
2	4JD	MacLeod-Cockshutt Gold Mines Ltd.	Gold
2	4JD	Newrick Explorations Ltd. (Theresa Mine)	Gold
2	4JD	Tombill Mines Ltd.	Gold
2	2BB	Noranda Mines Ltd. (Geco Mine)	Copper, Zinc, Gold
2	2BB	Willecho Mines Ltd.*	Copper
2	2BB	Willroy Mines Ltd.*	Copper, Zinc, Silver
3	2BD	Alden Goudrea Mine (Michael Boyle)	Gold

TABLE 8 (cont'd)

MINE TAILINGS DISPOSAL SITES IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

SUB-BASIN	WATER-SHED	DESCRIPTION	MINERALS
3	2BD	Algoma Steel Corp.	
3	2BD	A and Bear Pits	Iron
3	2BD	MacLeod, Helen, Victoria, Alexander Mine*	Iron
3	2BD	Magpie Mine	Iron
3	2BD	Rand No. 1 and C pits	Iron
3	2BD	Sir James Mine*	Iron
3	2BD	Algoma Summit Mine	Gold
3	2BD	Amherst (New Goudreau Mine)	Gold
3	2BD	Michipicoten Iron Mines	Iron
3	2BD	Parkhill, Darvin (Grace), Smith Mines	Gold
3	2BD	Pick Mines Ltd. (Cline Lake Mine)	Gold
3	2BD	Surluga Gold Mines Ltd. (Jubilee, Minto, Deer Lake Mines)	Gold
3	2BD	Renabie Mines Ltd.*	Gold
3	2BF	Kristina (Supercrest) Mine	Copper
3	2BF	Sheridan Geophysics Ltd. (Copper Corp)*	Copper
3	2BF	North Canadian Enterprises Ltd.*	

* active mine

WASTE DISPOSAL SITES (1)

INTRODUCTION

The tabulated data on waste disposal sites (Tables 9 to 11) were assembled for Environment Canada. They include liquid, solid, hazardous material and deep well disposal sites which were licensed by the Waste Management Branch of the Ontario Ministry of the Environment as of January 31, 1974. The methodology used in the data collection is described in Appendix A of Volume I in this report series.

The column headings in Tables 9 to 11 are defined as follows:

No.	- An arbitrary code assigned for mapping purposes.
MOE No.	- Permit number in Ontario Ministry of the Environment (Waste Management Branch) records.
Municipality	- Municipality in which the disposal area is situated.
Opened	- Date on which the site was opened. If no figure is entered, the site was opened prior to 1971.
Closed	- Date of closure.
Area	- Site area (acres).
Population Served	- Operator's estimate of the population served.
Waste Type	- S - Solid, L - Liquid, H - Hazard
Volume	- Listed in tons/day unless otherwise noted.
Proj. Life	- Life, as estimated in 1971 when the licence was first issued, or on the opening date.
Watershed	- This identifies the sub-drainage basin in which the site is located, in accordance with the Canada Water Survey classification.

SUB-BASIN 1: KAMINISTIKWIA RIVER

Table 9 presents a listing of the waste disposal sites in the Kaministikwia Sub-Basin. Nearly all of them deal exclusively with solid waste. However, there are two sites in Thunder Bay which dispose of liquid waste and hazardous materials, respectively.

This sub-basin contains more waste disposal sites than the other Canadian Lake Superior sub-basins. It also receives the majority of the waste volume in the Canadian Lake Superior Basin.

TABLE 9
WASTE DISPOSAL SITES IN THE KAMINISTIKWIA RIVER SUB-BASIN (SUB-BASIN 1)

NO.	MOE NO.	MUNICIPALITY	OPENED	CLOSED	AREA (acres)	POPULATION SERVED	WASTE TYPE	VOLUME	1971 PROJECT LIFE	WATERSHED
		THUNDER BAY DISTRICT								
1481	D7254901	Hagley Twp.			1.2		S		3	2AB
1482	D7254801	Conacher Twp.			0.8		S		4	2AB
1483	D7252701	Ware Twp.			4.0	40	S	1/10	15	2AB
1484	D7252702	Ware Twp.			4.0	150	S	1/4	15	2AB
1485	D7254902	Hagley Twp.			0.4		S			2AB
1492	D590401	Conmee Twp.			4.0	370	S	1/4		2AB
1436	D590901	O'Connor Twp.			8.0	460	S	1/2	20	2AB
1437	L591001	Oliver Twp.			0.7	800	S	2	10	2AB
1438	L591002	Oliver Twp.				250	S	1/2		2AB
1439	L591003	Oliver Twp.			64.0	1,337	S	6-8/wk	100	2AB
1440	L591101	Paipoonge Twp.			8.0	2,339	S	4	80	2AB
1431	D590402	Conmee Twp.			20.0	337	S	1/4	50	2AB
1432	D590501	Gillies Twp.			2.3	361	S	15		2AB
1433	D590701	Neebing Twp.			1.2	550	S	1/8	25	2AB
1450	D591601	Dorion Twp.			1.2		S	1		2AC
1475	D7225001	Haines Twp.								2AB
1476	L7225002	Haines Twp.			2.8	300	S	2	5	2AB
1477	D7239801	Gillies Twp.			0.8	538	S	0.5	20	2AB
1478	D7300901	Hardwick Twp.			4.0	250	S	1/10	20	2AA
1479	D7300902	Hardwick Twp.			4.0	50	S	1/10	10	2AA
1495	D590003	S. of Kashabowie			0.4		S			2AB
1496	D590004					100	S	1/10	10	2AC
1442	L591301	McGregor			4.0	500	S	2	20	2AC
1443	L591302	McGregor Twp.			1.2		S	1/2		2AC
1444	L591303	McTavish Twp.			0.4	300-400	S	1/2	2	2AC
1445	L591304	McTavish Twp.			0.4		S			2AC
1446	L591305	McTavish Twp.			0.8	15-300	S	1/4		2AC
1447	L591306	McGregor Twp.			8.0	2,000	S	5	10	2AC
1459	D7053401	Fowler Twp.			4.0	200	S	1/20	20	2AB
1460	D7053402	Fowler Twp.			4.0	250	S	1/10	20	2AB
1461	D7053403	Fowler Twp.			4.0	500 - summer	S	1/4	20	2AB
1462	D7078201	Jacques Twp.			4.0	75	S	1/10	20	2AC

TABLE 9 (cont'd)

WASTE DISPOSAL SITES IN THE KAMINISTIKWIA RIVER SUB-BASIN (SUB-BASIN 1)

NO.	MOE NO.	MUNICIPALITY	OPENED	CLOSED	AREA (acres)	POPULATION SERVED	WASTE TYPE	VOLUME	1971 PROJECT LIFE	WATERSHED
1463	D7078202	Jacques Twp.				60	S	1/10	15	2AC
1466	D7119002	Pearson Twp.			4.0	250	S	1/10	20	2AA
1467	D7131201	Scoble Twp.			4.0	50	S	1/10	20	2AB
1468	D7131202	Scoble Twp.			4.0	50	S	1/10	15	2AB
1469	D7137601	Stirling Twp.			0.4	200	S		15	2AC
1470	D7138401	Strange Twp.			6.0	50	S	1/10	15	2AB
1471	D7138402	Strange Twp.			4.0	200	S	1/10	15	2AB
1504	D590013	Hardwick Twp.			4.0	75	S	1/10	20	2AA
1505	D590014	W. of Hardwick Twp.			4.0	25	S	1/20	15	2AA
1506	D590101	City of Thunder Bay			6.3		S,L	25	12-13	2AB
1507	D590104	City of Thunder Bay		15/11/72	2.0	5,000	S		1	2AB
1508	D590105	City of Thunder Bay		15/11/72	8.0		S	10	1	2AB
1509	L590106	City of Thunder Bay			140.0	107,000	S	332	30	2AB
1510	L590107	City of Thunder Bay			28.0		S	70		2AB
1511	L590108	City of Thunder Bay			0.2		S,H	2	6-7	2AB
1512	L590109	City of Thunder Bay			36.0		S			2AB
1513	L590111	City of Thunder Bay			12.0		S	10	30	2AC

No information presented indicates data not available, unless otherwise noted.

hectares = acres x 0.4047

TABLE 10
WASTE DISPOSAL SITES IN THE NIPIGON-LONGLAC-WHITE RIVERS SUB-BASIN (SUB-BASIN 2)

NO.	MOE NO.	MUNICIPALITY	OPENED	CLOSED	AREA (acres)	POPULATION SERVED	WASTE TYPE	VOLUME	1971 PROJECT LIFE	WATERSHED
		THUNDER BAY DISTRICT								
1493	D590001	North of Twp. 71			2.4	500	S,L	1	20	2BC
1430	L590301	Geraldton			1.2	3,097	S	10		4JD
1448	L591401	Terrace Bay Twp.			3.2	1,833	S	.5	30	2BA
1449	L591501	Beardmore Twp.			2.0	796	S	10/wk		2AD
1441	D591201	Schreiber Twp.			2.0	2,100	S	4	20	2BA
1480	D7268501	Daley Twp.			2.0	1,470	S	4		4JD
1434	L590801	Nipigon Twp.			1.6	2,200	S	3.5	40	2AD
1435	L590802	Nipigon Twp.			0.4	2,800	S	26	2	2AD
1472	D7185601	Leslie Twp.			2.0	30	S	1/8	20	2BB
1473	D7198201	Croll Twp.			0.2		S			4JD
1474	D7207801	91 Twp.			0.8	40-summer	S	6 ton/yr	20	2AE
1464	D7086801	Leduc Twp.			2.0	600	S	1/2	10-15	2AD
1465	D7088401	Lindsley Twp.			0.6		S		3	4JD
1451	L591702	Manitouwadge			2.0	3,200	S	3	20	2BB
1452	L591801	Marathon Twp.			8.0	2,453	S	8	20	2BA
1453	L592001	Red Rock District			1.8	2,000	S	10	25	2AD
1454	L592002	Red Rock District			2.0		S	8.17	34	2AD
1455	D7006201	Geraldton			0.4		S	3	10	4JD
1456	D7006202	Geraldton			2.0	132-summer	S	2	20	4JD
1457	D7006501	Twp. 85				120	S			2BA
1458	L7004401	Geraldton			1.9	3,200	S	7	14	4JD
1498	D590006				0.4		S		10	2BB
1499	D590008				0.8	30	S	1/4	5	4JD
1500	D590009				1.6	100	S	50 ton/yr	20	2BB
1502	D590011				0.4	60	S	6	10	2AD
1503	L590012					300	S			4GB
1486	D7420101	Twp. 86			1.2	58-summer	S	50 ton/yr	10	2BA
1487	D7407702	Twp. 89			0.8	20	S	6 ton/yr	20	2AE
1488	D7407701	Twp. 90			0.8	6	S	1 ton/yr	20	2AE
1489	D7372901	Kitto Twp.			2.4	500	S	1/2	4	2AD
1490	D7312501	Twp. 78				10	S	2 ton/yr		2BA
1491	D7312502	Twp. 78				10	S	2 ton/yr		2BA
		ALGOMA DISTRICT								
1372	D562201	White River Dist.			1.6	1,000	S	3	10	2BC
1401	D7189601	Magone Twp.			1.2	100	S	1/4	20	2BC

No information presented indicates data not available,unless otherwise indicated.

hectares = acres x 0.4047

TABLE 11

WASTE DISPOSAL SITES IN THE MAGPIE-MICHIPICOTEN-MONTREAL RIVERS SUB-BASIN (SUB-BASIN 3)

NO.	MOE NO.	MUNICIPALITY	OPENED	CLOSED	AREA (acres)	POPULATION SERVED	WASTE TYPE	VOLUME	1971 PROJECT LIFE	WATERSHED
		ALGOMA DISTRICT								
1410	L7410801	Pearkes Twp.			0.2	40	S	1/8	10	2BD
1389	D7164101	43 Twp.			0.4	25	S	100 lb/day	20	2BD
1390	D7164301	46 Twp.			0.4	200	S	1/4	10	2BD
1400	D7180701	30 Twp.			0.2	600	S	1/2	5	2BD
1381	L7145601	VanKoughnet Twp.			0.8		S	10	10	2BF
1377	D7068201	Havilland Twp.			6.1	3,000	S	1.5	20	2BF
1378	D7128401	Ryan Twp.			13.2	50	S	1.5	20	2BF
1374	D7051201	Fanwick Twp.			18.4	5,000	S	3	20	2BF
1375	D7052201	Fisher Twp.			9.3	3,000	S	1.5	40	2BF
1421	L7256801	Twp. 31			0.6	600	S	1	2-5	2BD
1422	D7256802	Twp. 31			0.8		S	1/2	15	2BD
1367	D561401	Michipicoten Twp.			1.6	4,847	S	12	2	2BD
1383	D7149801	Whitman Twp.			2.3	100	S	10	20	2BF
1354	D560002	Twp. 25 Range 18			0.4	40	S	1/8	20	2BE
		SUDBURY DISTRICT								
1321	D7120501	Peters Twp.			0.2	30	S	25 lb/day	15	2BD
1322	D7120502	Peters Twp.			0.4	150	S	1/4	10	2BD

No information presented indicates data not available,unless otherwise indicated.

hectares = acres x 0.4047

SUB-BASIN 2: NIPIGON - LONG LAC - WHITE RIVER

The waste disposal sites in the Nipigon-Long Lac - White Sub-Basin are described in Table 10. The 34 active sites all serve small populations and, therefore, handle relatively small amounts of waste. One site handles both liquid and solid waste, while the other handle only solid waste. There are no hazardous material disposal sites in this sub-basin.

SUB-BASIN 3: MAGPIE - MICHIPICOTEN - MONTREAL RIVER

The waste disposal sites in the Magpie - Michipicoten - Montreal Sub-Basin are listed in Table 11. This sub-basin has a small population and consequently, produces only a small amount of disposable waste. There are only 16 active sites, handling about 40 t/d (88,000 lb/d) of solid waste.

SUMMARY

Table 12 contains a summary of waste disposal sites for the Canadian portion of the Lake Superior Basin. There are a total of 97 sites in the Basin, which cover a land area of 516 ha (1275 acres). Approximately 557 t (1.22 million lb) of waste are applied to these sites daily.

Land used for waste disposal is concentrated in the Kaministikwia Sub-Basin, because it contains Thunder Bay, the only large population centre in the Canadian Lake Superior Basin. Most of the volume of waste disposed of in the Canadian Lake Superior Basin (77 percent) is disposed of in the Kaministikwia Sub-Basin.

TABLE 12

WASTE DISPOSAL SUMMARY FOR THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

Watershed	No. Active Sites	Approx. Area (ha)	Volume (t/d)	No. Closed Sites	Approx. Area (ha)
Kaministikwia Sub-Basin	47	411	428	2	10
Nipigon-Long Lac-White Sub-Basin	34	50	89	-	-
Magpie-Michipicoten-Montreal Sub-Basin	16	55	40	-	-
Total Canadian Lake Superior Basin	97	516	557	2	10

acres = hectares (ha) x 2.471
pounds/day (lb/d) = tonnes/day (t/d) x 2200

EROSION (2,3)

LAKESHORE EROSION

Little erosion takes place on the Canadian shoreline of Lake Superior because most of the shore is rocky and non-erodible.

The only Canadian area on Lake Superior that shows evidence of direct erosion from wave action is a small area near the Montreal River, in Sub-Basin 3. Gravel banks, 6 meters high at this location, are being eroded.

RIVERBANK EROSION

As of this writing, no data are available on riverbank erosion in the Canadian Lake Superior Basin. However, studies are currently being conducted as part of the PLUARG programme.

INTENSIVE LIVESTOCK OPERATIONS (4)

As of this writing no data are available on intensive livestock operations in the Canadian Lake Superior Basin.

HIGH DENSITY, NON-SEWERED RESIDENTIAL AREAS

INTRODUCTION

The information on non-sewered residential areas (Tables 12 to 14) was taken from a study conducted for Environment Canada (1). Details of the methodology are presented in Appendix A of Volume I in this report series.

Since this study was to include both permanent and seasonal residences, compact groupings of cottages or chalets were included. In the case of seasonal residences, the number of units was tabulated. This was translated to an equivalent population, using a factor of 3.5 persons per unit. This same practice was followed for permanent residences in some municipalities. These estimated populations are included under the heading "total population" in Tables 13, 14 and 15.

SUB-BASIN 1: KAMINISTIKWIA RIVER

Table 13 presents a listing of the non-sewered high density residential areas in Sub-Basin 1. There are only three such areas in this sub-basin. The largest being located in Neebing Township, south of Thunder Bay, with a total population of 3,590.

SUB-BASIN 2: NIPIGON - LONG LAC -WHITE RIVERS

The location and size of non-sewered high density residential areas in Sub-Basin 2 are presented in Table 14. All of the 11 non-sewered areas in this sub-basin have populations less than 1000, and most are less than 200. The total non-sewered population in Sub-Basin 2 is 3397.

TABLE 13

NON-SEWERED RESIDENTIAL AREAS IN THE KAMINISTIKWIA RIVER SUB-BASIN
(SUB-BASIN 1)

TOWNSHIP	BASIN	LOCATION	KNOWN POPULATION	TOTAL POPULATION
Thunder Bay County				
Oliver	2AB	Murill	280	280
Paipoonge	2AB	Rosslyn	220	220
Neebing	2AB	South of Thunder Bay	3590	3590
Sub-Basin 1 Total				4090

TABLE 14

NON-SEWERED RESIDENTIAL AREAS IN THE NIPIGON-LONG LAC-WHITE RIVERS SUB-BASIN
(SUB-BASIN 2)

	Township	Basin	Location	Known Population	Total Population
Thunder Bay County:	-	2AD	Auden	21	21
	-	2AD	Armstrong	348	348
	Leduc	2AD	Jellicoe	179	179
	Summers	2AD	Beardmore	662	662
	Kilkenny	2AD	Macdiarmid	139	139
	86	2BA	Rossport	108	108
	Pic	2BB	Heron Bay	125	125
	-	2BB	Hillsport	185	185
Algoma County:	Hunt	2BC	White River	847	847
	Thessalon	2BA	Little Rapids	75	75
	Thessalon	2BA	Thessalon	708	708
Sub-Basin 2 Total					3397

TABLE 15

NON-SEWERED RESIDENTIAL AREAS IN THE MAGPIE-MICHIPICOTEN-MONTREAL RIVERS SUB-BASIN
(SUB-BASIN 3)

	Township	Basin	Location	Known Population	Total Population
SUDBURY COUNTY:	11 H	2BE	Pineal Lake	90	90
ALGOMA COUNTY:	Tp. 29 Rg. 23	2BD	Near Wawa	200	200
	Tp. 28 Rg. 24	2BD	Hawk Jct.	318	318
	Pearkes	2BD	Franz	66	66
	49	2BD	Dubrevilville	684	684
	43	2BD	Dalton	60	60
	46	2BD	Missanabie	100	100
	NAES	2BF		150	150
	Fenwick	2BF		800	800
	Havilland	2BF		300	300
	Hodgins	2BF		200	200
	Fisher	2BF		300	300
	Tilley	2BF		300	300
	Van Koughnet	2BF		600	600
Sub-Basin 3 Total					4168

SUB-BASIN 3: MAGPIE - MICHIPICOTEN - MONTREAL RIVERS

High density, non-sewered residential areas in Sub-Basin 3 are presented in Table 15. The non-sewered population in this sub-basin constitutes 66 percent of the total sub-basin population. However, in absolute terms, the population (4168 persons) is relatively small. All the non-sewered residential areas have populations less than 800 persons, with the average size being 298 persons.

SUMMARY

The Canadian portion of the Lake Superior Basin contains 28 high-density, non-sewered residential areas, with a total population of 11,655. This non-sewered population represents 8 percent of the total Lake Superior population and is distributed evenly among the three sub-basins.

REFERENCES

1. Crysler and Lathem. Land Drainage Reference Study Task B2: Mine Tailings Disposal Sites, Waste Disposal Sites, Non-Sewered Residential Areas, Land Fill Sites, report prepared for Canada Department of the Environment.

2. Environment Canada and Ontario Ministry of Natural Resources. Canada-Ontario Great Lakes Shore Damage Survey Technical Report, October 1975.

3. Task Force on Available Shore Erosion Information on the Great Lakes - St. Lawrence System. Shore Erosion on the Great Lakes - St. Lawrence System, Part 2 - Shore Erosion on the Great Lakes System, Government of Canada, 1973.

4. Coote, D.R., E.M. MacDonald, and M.D. Rigby. A Selective Inventory of Large Livestock Operations, Southern Ontario, Agriculture Canada, Ottawa, 1974.

4 MATERIALS USAGE

INTRODUCTION

The materials initially identified in this inventory were chosen because they may influence the quality of drainage water in the Lake Superior Basin. These materials included pesticides, fertilizers, agricultural manures, road salts and agricultural lime and liming materials. Lime was subsequently deleted in the following discussion because of its limited use.

The methodology used in the materials usage inventory is described in Appendix A of Volume I in this report series.

AGRICULTURAL PESTICIDES

The quantities of pesticides used for agriculture are very low in the Canadian portion of the Lake Superior Basin.

The quantities of pesticides used for forestry are probably far greater than the quantities used for agriculture. However, the use of pesticides in forestry were not considered in this report.

INSECTICIDES

There were an estimated 211 kg (465 lb) of insecticide used in the Canadian portion of the Lake Superior Basin in 1973, all applied to field crops. The insecticide applied was methoxychlor, an organo-chlorine insecticide.

FUNGICIDES

There were no reported uses of fungicides for agricultural purposes in the Canadian portion of the Lake Superior Basin in 1973.

HERBICIDES

There were 327 kg (721 lb) of phenoxy herbicide used in the Canadian Lake Superior Basin in 1973, primarily on field crops.

COMMERCIAL FERTILIZERS AND AGRICULTURAL MANURES

Information on the production and/or usage of agricultural manures and fertilizers in the Canadian portion of the Lake Superior Basin is presented in terms of their nutrient content.

Farmland use and livestock numbers for the Kaministikwia Sub-Basin are presented in Tables 16 and 17, respectively.

TABLE 16

FARMLAND USE IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN, 1971 (ha)

Sub-Basin	Number of Farms	Total Farmland	Improved Farmland	Area Under Crops	Pasture	Woodland
Kaministi-kwia R.	419	43,200	19,700	13,400	4,400	14,300

acres = hectares (ha) x 2.471

TABLE 17

LIVESTOCK NUMBERS IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN, 1973

Sub-Basin	Total Cattle	Dairy Cattle	Beef Cattle	Swine	Poultry
Kaministi-River	11,900	8,200	2,800	1,800	130,000

COMMERCIAL FERTILIZERS

The estimated annual usage of fertilizer nutrients in the Canadian portion of the Lake Superior Basin is as follows: 587,500 kg nitrogen (1.30 million lb); 589,250 kg phosphorus (P_2O_5) (1.30 million lb); and 606,500 kg potassium (K_2O) (1.34 million lb).

AGRICULTURAL MANURES

The amounts of manure nutrients produced annually in the Canadian Lake Superior Basin are as follows: 633,470 kg nitrogen (1.40 million lb); 475,400 kg phosphorus (P_2O_5) (1.05 million lb) and 737,830 kg potassium (K_2O) (1.63 million lb).

COMBINED FERTILIZERS AND MANURES

The total nutrients applied to the Canadian portion of the Lake Superior Basin from fertilizers and agricultural manures are as follows: 1,220 t nitrogen (2.68 million lb); 1,065 t of phosphorus (P_2O_5) (2.34 million lb); and 1,340 t of potassium (K_2O) (2.95 million lb).

ROAD SALTS

The use of road salt is very limited in the Canadian Lake Superior Basin because of the small number of paved roads present there, as well as extremely cold winter temperatures which render the use of road salts ineffective. The salt indicated is rock salt or sodium chloride, which is composed of 94 to 97 percent pure sodium chloride, plus small quantities of chlorides, carbonates and sulphates of calcium and magnesium.

Calcium chloride is also used as a de-icing agent, although its use amounts to less than one percent of the amounts of sodium chloride used. Calcium chloride is used in the summer as a dust control agent on gravel surfaces. However, quantitative figures were not obtained for calcium chloride because of its relatively low overall usage.

In an average winter, 28,400 t of salt (62.5 million lb) are applied to roads in the Canadian Lake Superior Basin. Its use is limited primarily to the City of Thunder Bay and the north shore of Lake Superior.

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Domtar Chemicals Ltd., Sifto Salt Division.

Economics Branch, Ontario Ministry of Agriculture and Food.

Iroquois Salt Products Ltd.

Maintenance Branch, Ontario Ministry of Transportation and Communications.

Soils and Crop Branch, Ontario Ministry of Agriculture and Food.

Water Resources Branch, Ontario Ministry of the Environment.

5 FUTURE TRENDS

POPULATION

The population forecasts presented in Table 18 were compiled by the Regional Planning Branch of the Ontario Ministry of Treasury, Economics, and Intergovernmental Affairs (1). A basic assumption underlying these forecasts is that there will be no major intervention in current trends in the form of development projects or special government policies.

Table 18 contains population projections for the Canadian portion of the Lake Superior Basin and its three major sub-basins, for the years 1981, 2001 and 2021. These projections reflect a slower growth rate than forecast for the rest of the Canadian Great Lakes Basin. Population in the Canadian Lake Superior Basin is projected to grow from 147,914 in 1971 to 181,000 in 2021. This increase represents an annual growth rate of 0.4 percent. The distribution among the three sub-basins should remain about the same, as the present time, with about 75 percent of the population located in the Kaministikwia River Sub-Basin (Sub-Basin 1).

TABLE 18

POPULATION PROJECTIONS FOR THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

Sub-Basin	1971	1981	2001	2021
Kaministikwia	115,294	121,578	130,386	137,337
Nipigon-Long Lac-White	26,280	27,808	30,051	31,894
Michipicoten-Magpie-Montreal	6,340	7,316	9,383	11,794
Total Canadian Lake Superior Basin	147,914	156,702	169,820	181,025

ECONOMIC ACTIVITY

The economic activity projections presented here were produced by Informetrica Limited (2). Details concerning methodology were presented in Appendix A of Volume I in this report series.

Two sets of estimates were made, Series A and Series B.

Series A postulates a world economy in which basic resources are continually in short supply. This is reflected in two ways:

a) a rapid growth in world prices of several major commodity groups, mainly associated with metals, mining and energy will occur; and

b) the assumption that Canadian suppliers of these goods will respond by providing a rapid growth in the volume of these goods that are exported.

Over the long period under review in this study, the growth of economic output will be a function of the growth in the labour force, increases in productivity per worker, and the ability of policy makers to keep the economy continuously operating at or near "potential", with acceptable price increases. It is assumed that governments will operate the economy at close to the potential, accepting an average annual increase of about 4.1 percent in prices in the long term as measured by the implicit deflator of Gross National Product. This rate is somewhat higher than has been experienced in the post-World War II period and reflects the general assumption of a continued world scarcity of basic resources.

Growth of the supply of labour is related to the growth of the population eligible to work and the willingness of that group to participate in the labour force. The past generation has seen a steady decline in the average hours worked per week. It is anticipated that this trend will continue, the average falling from a present 36 hours per week to about 27 in 2020. On the other hand, there has been a clear tendency for people to participate (albeit in the reduced work week) in the past. This is attributable primarily to the increased rate of women's participation. It is expected that this trend will also continue. The participation rate of women under the age of 35 is projected, for example, to rise from a present 45 percent to almost 80 percent in 2020. Overall, it is projected that the participation rate will rise from its current 58 percent to almost 65 percent in 2020.

Consequently, the labour force can be expected to grow at an average annual rate of about 1.5 percent in 1974-2020. This factor, together with a growth in output per labourer averaging about 2.7 percent annually, yields an expected average annual growth of 4.2 percent of the Gross National Product (in constant dollar terms). The pattern over time is interesting. The potential for rapid growth is almost certain to deteriorate over time, as the growth of the labour force slows. Thus, in 1974-1990, the economy can potentially grow at an average annual rate of about 4.8 percent. However, from 1991 through 2020, this potential is restricted by the slow growth of the labour force to about 3.8 percent per year.

To support the rapid growth of government services, it is assumed that taxes will be such that disposable personal income per capita will grow slightly less rapidly than Gross National Product. Nevertheless, this indicator of economic well-being will continue to increase at an average annual rate of 3.0 percent in 1974-2020. This rate is only slightly less than that which was maintained in the 1960's. In terms of 1961 prices, per capita disposable income will rise from $4,950 in 1974 to $9,410 in 2020.

The consumption of public goods and services, as measured by government current expenditures, is projected to provide an increasing share of total expenditures at the expense of private consumption. Under conditions of a slowly growing population, this is a reasonable projection if the economy is to operate at its full potential. Among private consumption items, expenditures for services and durable goods can be expected to grow most rapidly, as has been the case in the past decade.

Demand generated for investment is projected to provide 21-22 percent of total expenditures, of which the private sector is expected to provide an even greater amount. The one significant contrast between the experience of recent years and that expected in future years is in the projection for residential construction, which is projected to grow slowly and to decline as a proportion of total expenditures. This can be attributable to the projected pattern of population growth. The formation of new households, which has grown rapidly in the past decade, can be expected to increase at slower rates in the future. Domestic savings should be sufficient to finance investment throughout most of the period. Business and government can be expected to provide increasing shares of total savings, particularly after the mid-1980's. Until that time, low dependency ratios (i.e., the ratio of the number of persons not in the labour force to those employed) should cause personal savings to rise rapidly.

In Series B by the year 2020, exports (in current dollars) are about 23 percent less than in the Series A simulation. This is accomplished by assuming that:

a) world prices for uranium, coal, iron ore and automobiles grow less rapidly after 1985, and

b) the volume of exported uranium, coal and iron ore grows more slowly, reflecting a diversion of investment interest from those sectors of the economy.

In constant dollar terms, exports in 2020 are 10 percent less than in Series A.

Such assumptions would lead to a much slower increase in economic activity and would yield a sustained high rate of unemployment. This will provide the rationale for governments to sufficiently increase transfers to persons, in order to generate domestic demand that will again lead (as in Series A) to an economy operating at "potential".

Given that policy is set to yield growth at "potential" in both simulations, the trace of economic activity in the alternative forecasts will be less broadly distinguished than would be the case if major structural differences in the economy were allowed. The changed external assumptions will have a major depressive effect, for example, on the output of the mining industry. But, because of the compensation for the slack foreign demand, this depressive effect will be partially offset. It is, of course, possible to perceive of alternative simulations that are radically differentiated. However, most of those would entail the articulation of major changes to the institutional and behavioural structure of the economic system. Such an articulation would be a major task.

Given the underlying policy assumption, the results of Series B, as measured by such major aggregates as Gross National Product, the Consumer Price Index, and Personal and Disposable Income, are very similar to those of Series A. In Series B, Disposable Personal Income per person in 2020 amounts to $9,710 (in 1961 dollars) as compared to $9,410 in Series A. Most of the major characterizations detailed above for Series A apply to this simulation as well.

The Series A economic activity projections for the Canadian portion of the Lake Superior Basin are presented by major industrial group in Table 19. Total economic output is projected to increase by a factor of seven from 515.71 (millions of 1961 dollars) in 1972 to 3766.28 in 2020. The share of total output attributable to the mining industry is projected to increase from 8 to 12 percent. The economic output of the land-based industries (i.e., agriculture, forestry and fisheries) is projected to remain a constant three percent of the total economic activity over the 50 year forecast period. Manufacturing's share of total output is forecast to decline slightly from 31 to 29 percent. Likewise construction is projected to decrease its share from five percent to four percent over the study period.

TABLE 19

ECONOMIC ACTIVITY PROJECTIONS FOR THE CANADIAN LAKE SUPERIOR BASIN, SERIES A

Real Domestic Product by Major Industrial Group (millions of 1961 dollars)

	1972	1980	2000	2020
Agriculture	0.73	1.00	2.06	4.44
Forestry	15.31	25.09	52.27	104.16
Fisheries	0.26	0.28	0.39	0.61
Mining	43.05	70.51	171.61	447.13
Manufacturing	158.12	243.10	500.94	1105.12
Construction	25.16	38.40	74.15	149.79
Trans.,Utilities Trade & Other	273.08	433.16	941.71	1955.03
Total Output All Sectors	515.71	811.54	1743.13	3766.28

MAJOR LAND USES

AGRICULTURE

The following agricultural land use forecasts are based upon trend projections, upon alternative assumptions of technological advance, and upon the assumption that political or economic factors will force agricultural output to grow in step with population (3).

The transition of traditional, labour-intensive farming to its modern capital-intensive form has been an essential part of the creation of the present structure of the economy. Rapid growth in agricultural productivity has resulted in the release of labour and land to other sectors of the economy, while permitting absolute growth in the volume of agricultural commodities produced. These changes have been brought about through intensified use of intermediate inputs, especially machinery, fertilizers and pesticides.

The last few years have been rather different from those experienced by the economy over the entire 1950-1974 period. In 1973, and again in 1974, real wages and salaries dropped from the previous year's levels. These were the only times that this has happened in recent years. Furthermore, only in the seventies has the agricultural sector improved its position, relative to the rest of the economy. If these are not temporary phenomena, future trends in agriculture will bear little resemblance to the past. The outflow of land and labour will cease, and perhaps even reverse. In the forecasting exercise, this is the most critical question.

In a pessimistic scenario, it is assumed that these aggregate events will signify a turning point. The area of land required to sustain the consumption standards of a fixed number of people cannot be expected to decline as dramatically as it has in the past. Therefore, through price-induced resources movements, or through government economic directives, the present decline in the land base of agriculture will be halted.

In an alternative optimistic scenario, it is assumed that the events of the recent past are a short run aberration and that agriculture will return to its typical pattern of rising yields and reduced acreages.

In both scenarios it is assumed that either market forces or government intervention will ensure basic food production. Specifically, it is assumed that the physical volume of agricultural production will grow over any period at a constant proportion of the growth rate of Ontario population*. For a detailed discussion of methodology, see Appendix A of Volume I in this report series.

** A key omission in this study is the relationship between Ontario agriculture and the rest of the world. The implicit assumption of the present study is that Ontario will not increase its net reliance on outside agriculture at a faster rate than it has in the past.*

The agricultural land use forecasts are presented by sub-basin groups in Table 20. The alternative forecasts of agricultural land use indicate radically different futures for the Canadian Lake Superior landscape. In the optimistic scenario, which is based upon the assumption that agricultural yields will continue to improve over the forecast period, the total area used by agriculture is projected to decline from 26,300 ha (65,000 acres) in 1971 to about 7,700 ha (19,000 acres) in 2020.

In the pessimistic scenario, which is based on the assumption that an upper limit to yields is being approached, agricultural land is projected to decline over the period from 1971 to 2020. Subsequently it will increase, reaching 20,000 ha (49,400 acres) by 2020.

The distribution of farmland among the 3 major sub-basins is forecast to remain about the same, with nearly all of the farmland being located in Sub-Basin 1. A small amount will be present in Sub-Basin 3, while none is forecast for Sub-Basin 2.

Which scenario will best approximate the future? This depends on the nature of technological advance in agriculture. It depends also on the nature of the decision-making process in agriculture. Will broad trends in agriculture be set by the decisions of isolated producers responding to the product prices, land prices, and factor prices that are established in the world of monopolies that surrounds them; or will the broad trends of agriculture be established by state intervention, based upon a normative evaluation of the cost of resource use and of the value of alternative categories of consumption? Finally, what is becoming more scarce: farmland; energy; or the ability of the environment to absorb larger doses of biocides and fertilizer? Many forces are acting upon agriculture and the resolution of these forces is not at all clear.

URBAN

The urban land use forecasts in this report are based upon a cross-sectional analysis of the relationship between urban population and urban area (4). They are basically unconstrained, assuming no more effective planning than exists now, and also that the economy will continue to be the major determinant of the urbanization process.

Two different methodologies were used. The first is the constant land consumption rate method, which is based on the assumption that any increments of urban population will occupy as much space per person as the current urban population. The second approach is the allometric method, which assumes that as population increases, urban area also increases, but at a slower rate, reflecting a higher density and more intense use of land in larger cities. Finally, a preferred forecast, called the declining land consumption rate forecast, which combines the best attributes of both methods, is also presented. A detailed description of the methodologies is presented in Appendix A of Volume I in this report series.

TABLE 20

AGRICULTURAL LAND USE FORECASTS FOR THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

(ha)

	1980		2000		2020	
Scenario:	Optimistic	Pessimistic	Optimistic	Pessimistic	Optimistic	Pessimistic
Kaministikwia River (Sub-Basin 1)	18,047	17,723	11,091	15,417	7,003	18,428
Nipigon-Long Lac-White Rivers (Sub-Basin 2)	0	0	0	0	0	0
Magpie-Michipicoten-Montreal Rivers (Sub-Basin 3)	2,163	2,146	1,247	1,746	681	1,588
Total Canadian Lake Superior Basin	20,210	19,869	12,338	17,163	7,684	20,016

acres = hectares (ha) x 2.471

DEFINITIONS

Urban Population, as defined in the 1971 Census of Canada, includes the population living in: (1) incorporated cities, towns and villages with a population of 1,000 or over; (2) unincorporated places of 1,000 or over, having a population density of at least 1,000 per square mile; and (3) the built-up fringes of (1) and (2) having a minimum population of 1,000 and a density of at least 1,000 per square mile.

Urban Area refers to the land actually used for residential, commercial, industrial, institutional or transportation purposes.

Land Consumption Rate is an intensity measure describing the relationship between urban population and urban area, expressed in hectares per 1,000 persons.

Urban land forecasts for the Canadian portion of the Lake Superior Basin are presented by Sub-Basin in Table 21. Total urban land is projected to increase by about 40 percent over the forecast period, from 8800 ha (2174 acres) in 1972 to 12,200 ha (30,146 acres) in 2020. This projected urban expansion will necessitate the conversion of land in other uses to urban use.

Recently, the Lands Directorate Environment Canada (5), studying the conversion of rural to urban land in the Canadian Lake Superior Basin found, in the Thunder Bay area, that about 56 percent of the newly-urbanized land from 1966 to 1971 had formerly been forested land. About 43 percent of the rural to urban conversion involved agricultural land. It is likely that future rural to urban land conversion in the Canadian Lake Superior Basin will follow the same pattern.

TABLE 21

URBAN LAND FORECASTS FOR THE CANADIAN PORTION
OF THE LAKE SUPERIOR BASIN
(ha)

Sub-Basin	1972	1980	2000	2020
Kaministikwia	6,727	7,084	8,283	8,814
Nipigon-Long Lac-White	387	387	387	387
Magpie-Michipicoten-Montreal	1,686	2,129	2,630	2,999
Total Canadian Lake Superior Basin	8,800	9,600	11,300	12,200

acres = hectares (ha) x 2.471

SUMMARY

Major land use projections for the Canadian Lake Superior Basin are summarized in Table 22. No major changes in land use are forecast. Urban land may increase; agricultural land may decrease; other (including recreational) land could increase; and forest land may decline slightly. But all these changes are small with respect to the size of the Basin, involving only about 1 percent of its total area.

TABLE 22

MAJOR LAND USE PROJECTIONS FOR THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN, 1972-2020 (1000 ha)

Land Use	1972 (base year)	1980	2000	2020
Urban	8.8	9.6	11.3	12.2
Agriculture	26.3	20.2	12.3	7.7
Forest	9,369.6	9,367.8	9,348.6	9,296.2
Other	54.0	61.1	86.5	142.6
Total Land Use	9,458.7	9,458.7	9,458.7	9,458.7

acres = hectares (ha) x 2.471

SPECIALIZED LAND USES

The five categories of specialized land uses, including waste disposal, erosion zones, intensive livestock operations, high density, non-sewered residential areas and recreational lands, bear no simple relationship with the standard economic and demographic variables. The future pattern and extent of specialized land uses in the Canadian Lake Superior Basin will be more a function of interacting social, technological and legislative factors than of population and economics. The forecasts in this section extend only to 1990 because of the great uncertainties involved in specialized land uses.

WASTE DISPOSAL

A major trend in waste disposal is toward fewer, but larger and better managed waste disposal sites. The numerous open dumpsites in the Canadian Lake Superior Basin are being closed as waste is consolidated into large sanitary landfill operations.

As population grows, there should be more waste, but the water quality implications of this increased waste are not yet clear.

The Province of Ontario has adopted a waste management program, called Resource Recovery, which uses every practical means available to recover all valuable resources from the waste produced in the Province, and at the same time to eliminate unnecessary waste (6). The program is designed to provide, in three five-year stages, all the facilities necessary for complete resource recovery to serve at least 90 percent of the population of Ontario, and all but eliminate the need for the landfill of waste.

If the above plan is implemented, and garbage is indeed transformed into a resource, waste disposal may not be a problem in the future.

EROSION

Lakeshore and riverbank erosion are basically natural processes caused by natural phenomena. It is likely these processes will continue at their present long term rates in the future. However, natural erosion can be accelerated by the clearing of vegetation and construction on shorelands. In order to prevent property damage and even loss of life, shoreline management programs will probably be implemented in the near future. Such programs would regulate development in erosion prone zones, and thereby prevent further man-caused erosion.

INTENSIVE LIVESTOCK OPERATIONS

Due to economies of scale and the escalating cost of land, the trend toward larger numbers of livestock confined to small areas will likely continue in the near future. However, if the animal waste is properly handled, it need not have a negative impact on water quality.

Beef cattle are expected to constitute an increasing proportion of the total number of cattle, due to a relative decline in the demand for dairy products.

HIGH DENSITY, NON-SEWERED RESIDENTIAL AREAS

The urban, high density, non-sewered residential areas are forecast to gradually be connected to municipal sewage systems. The rural component of the high density, non-sewered residential areas will likely increase along with increases in the rural, non-farm population.

Advances in private waste disposal system technology may contribute to improved efficiency, resulting in less pollution of ground and surface water.

RECREATIONAL LANDS

If the supply of recreational lands keeps up with the demand for recreation, it will likely increase in the future. Not only will there be a larger population, but an anticipated shorter work week will give each person more time for recreational pursuits.

MATERIALS USAGE FORECASTS

PESTICIDES

The current use of agricultural pesticides in the Canadian Lake Superior Basin is very low. Consequently, no forecasts of its use were prepared.

The use of pesticides in forestry operations is likely much greater than their use in agriculture, but no figures were available to provide substantiation.

FERTILIZERS

The volume of fertilizer that will be used by agriculture in the Canadian portion of the Lake Superior Basin in the future will depend, in a complex way, upon the area used by agriculture, prices of farm products, prices of fertilizers, environmental constraints and technical limits. Because of the uncertainty of long-run projections, most of these factors have been excluded from the agricultural forecasting exercise. However, the environmental implications of continued use of fertilizers make it important to consider the magnitude of their use in the future. A description of the methodology appears in Appendix A of Volume I in this report series.

The projected nutrient content of fertilizers used in the Canadian Lake Superior Basin is presented in Table 23 (7). The forecasts are very sensitive to the assumptions upon which they are based.

The factors behind the projections in Table 23 include the following:

1) an increasing proportion of the area under crops will be fertilized;
2) the total area under crops will continue to decline; and
3) there will be a shift to crops which require more intensive fertilization.

In the Canadian portion of the Lake Superior Basin, the forecasts indicate the rate of withdrawal of agricultural land will be very close to, or exceed, the forecast rate of increase in the proportion of the crop area fertilized. The projected result will be an overall decline in fertilizer nutrients in the Canadian Lake Superior Basin, from 1,012 t (2.22 million lb) in 1971 to 724 t (1.59 million lb) in 2020.

ROAD SALTS

The large volume of salt applied to roads is based upon the dominance of private motor vehicles. If private transportation is de-emphasized in the future, the need to keep roads free of snow and ice will be reduced. At the same time, however, emergency vehicles (e.g., fire engines, police cars, ambulances), buses and all forms of public surface transport will still be impeded by winter road conditions. Therefore, the extinction of the private vehicle would not mark the end of the environment-transportation conflict over deicing agents.

The use of road salt in the Canadian portion of the Lake Superior Basin is low, in comparison to the other Great Lakes both because of Lake Superior's low winter temperatures, which preclude the effective use of salt, and because of the small amount of roads in the area. Road salt is projected to increase to 30,287 t (66.6 million lb) in 1980, 34,684 t (76.3 million lb) in 2000, and 39,388 t (86.6 million lb) in 2020.

TABLE 23

FORECAST WEIGHT OF NUTRIENTS IN COMMERCIAL FERTILIZER USED BY AGRICULTURE IN THE CANADIAN PORTION OF THE LAKE SUPERIOR BASIN

(t/a)

	1971	1980	2000	2020
Nitrogen	320	301	337	230
Phosphorus (P_2O_5)	307	289	324	220
Potassium (K_2O)	285	364	408	274
Total Nutrients	1,012	954	1,069	724

pounds (lb) = tonnes (t) x 2200

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